

## A New Variety of *Thismia hexagona* Dančák, Hroneš, Koblová et Sochor (Thismiaceae) from Sabah, Borneo, Malaysia

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*Thismia hexagona* Dančák, Hroneš, Koblová et Sochor was recently reported from Brunei Darussalam. It is characterized by its unique yellow and brown coloration and sharply hexagonal flower annulus. Here, we also report its discovery during a botanical expedition in the Maliau Basin Conservation Area, Sabah, Borneo, Malaysia. The Malaysian individuals differ from the original description of *T. hexagona* in the opening angle and size of the perianth lobes. We therefore propose it as a new variety, *T. hexagona* var. *grandiflora* Tsukaya, M. Suleiman & H. Okada var. nov. Detailed morphological characters are provided.

Key words: Borneo, mycoheterotroph, new locality, Sabah, *Thismia hexagona*, Thismiaceae

The genus *Thismia* Griff. (Thismiaceae) comprises more than 45 mycoheterotrophic species (Jonker 1948; Merckx 2008; Merckx *et al.* 2013), including several species described within the past decade, such as *T. mullarensis* from Central Kalimantan (Tsukaya & Okada 2005), *T. betungkerihunensis* from West Kalimantan (Tsukaya & Okada 2012a), and *T. hexagona* from Brunei (Dančák *et al.* 2013). The majority of these species appear to have been collected only once or a few times. Since mycoheterotrophs are highly dependent on the activities of both the fungi and the trees that sustain them, the richness of the mycoheterotroph flora is a good indicator of the floristic richness of the forests in which they occur (Merckx *et al.* 2013). In other words, mycoheterotrophs are easily affected by ecosystem destruction. To conserve the biodiversity of tropical forests, we need additional information on the distri-

bution of such vulnerable mycoheterotrophs.

In our floristic studies in the Kalimantan area of Borneo we found one new genus, several new species, and a new variety of mycoheterotrophs (Tsukaya & Okada 2005, 2012a, 2012b, 2013a, 2013b, Tsukaya *et al.* 2011). Because Kalimantan has a rich diversity of mycoheterotrophs, we compared the mycoheterotroph floras of Kalimantan and Sabah, Borneo, starting with a botanical expedition in Maliau Basin Conservation Area, Sabah, with permission from the Maliau Basin Management Committee (YS/MBMC/2013/50) and Sabah Biodiversity Council [access license JKM/MBS.1000-2/2(152)]. We chose this area because Dr. Tim Utteridge, of the Royal Botanic Gardens, Kew, kindly showed one of us (HT) photographs of *Thismia* that he took in the conservation area. We suspected the photos to represent a new species of *Thismia*, based on oth-

er photos of *Thismia* taken by a professional photographer in Sabah, until the report of a new species *T. hexagona*, which looks similar, was published by Dančák *et al.* (2013). During our survey, we found three populations of *T. hexagona* flowering in the Maliau Basin Conservation Area. This is the first report of *T. hexagona* from Sabah. Because our collections have much longer perianth lobes than the typical variety, we describe them as *T. hexagona* var. *grandiflora* Tsukaya, M. Suleiman et H. Okada.

## Materials and Methods

### Flower structure

Some of the collections were preserved in 50% (v/v) ethanol. Microscopic photographs were taken in the field using a wireless digital microscope (3R-WM401PC, 3R Systems, Fukuoka, Japan).

## Results and Discussion

During the expedition from 15 to 20 August 2013, we found three populations of *Thismia hexagona* along a trail from the Studies Center to Seraya Camp in the Maliau Basin Conservation Area, Sabah (Fig. 1). Two of the population consisted of more than 40 flowers each (collection numbers: KKT-1, 15 August 2013, 04°44'29"N, 116°57'55"E, 235 m elevation; KKT-17, 18 August 2013, 04°45'40"N, 116°56'48"E, 528 m elevation).

When we compared the original description of *Thismia hexagona* by Dančák *et al.* (2013) with the plants in the Maliau Basin Conservation Area they appeared similar in having a bright yellow annulus, brown tube, and perianth lobes brownish with the upper half white (Fig. 1). The perianth lobes were 29–43 mm long in our specimens vs. 7–18 mm in the original description. The positioning of the perianth lobes also differed: the free parts of perianth lobes in our specimens opened nearly perpendicular to the axis of the perianth tube (Fig. 1), while Dančák *et al.* (2013) showed the elongating perianth lobes to be parallel to the floral axis. The number of flowers per

inflorescence was greater (1–3, mostly 2; Fig. 1) than in the original description, which noted that most individuals were 1-flowered, only a few were 2-flowered and one individual had three flowers (Dančák *et al.* 2013). The perianth tube was nearly the same in both; 12–16 mm long in our collection vs. 10–15 mm long in Dančák *et al.* (2013). The stem (Fig. 3) was also similar in both, but slightly taller in our plants, 10 cm tall in most of our collections, and 1.7–7 cm tall in Dančák *et al.* (2013). The most important features, namely the conspicuous, hexagonal flower annulus and morphology of the anther appendages (Fig. 2), were the same in both.

The differences were stable and shared among all individuals collected from two large populations (KKT-1 and KKT-17). We therefore concluded that the plants we collected represent a variety of *T. hexagona*.

### Taxonomic treatment

***Thismia hexagona* var. *grandiflora* Tsukaya, M. Suleiman & H. Okada, var. nov.** —Fig. 1.

*Thismia hexagona* var. *grandiflora* differs from *T. hexagona* var. *hexagona* in having much longer perianth lobes that open perpendicularly to the floral axis.

*Typus.* MALAYSIA, Maliau Basin Conservation Area, Sabah: 04°44'29"N, 116°57'55"E, 235 m alt., from the Studies Center to Seraya Camp, Maliau Basin Conservation Area, 15 Aug. 2013, H. Tsukaya, M. Suleiman & H. Okada KKT-1 (holo-BORH, iso-TI, KYO; part of specimen preserved in 50% ethanol, at all three herbaria).

Herbs, terrestrial, achlorophyllous, mycotrophic. Rhizomes + 10 cm, well developed, sometimes branched. Stem erect, simple, pale brown, glabrous, distally ridged longitudinally, 6–10 cm tall. Leaves few, appressed, scale-like, ca. 4 mm long, apex acute. Floral bracts similar to leaves, 8–9 mm long. Flowers (1–)2(–)3 per inflorescence. Perianth actinomorphic; tepals 6, basally fused into tube, apically lobed, lobes equal in size. Perianth tube ca. 12–16 mm long, pale brownish orange, with faint brownish longitudinal streaks and brownish purple apical stripe, widest at apex; annulus hexagonal, bright yellow

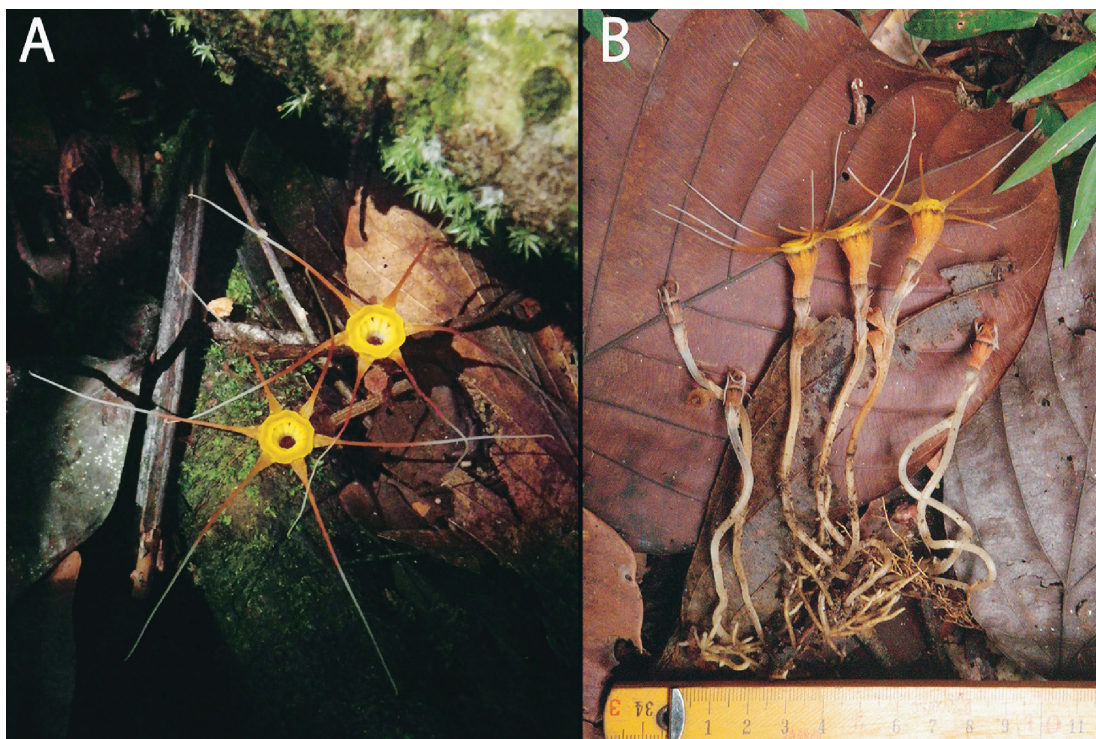


FIG. 1. *Thismia hexagona* var. *grandiflora* Tsukaya, M. Suleiman & H. Okada var. nov. in its native habitat (type locality). A, Flowers of *T. h.* var. *grandiflora*. B, Gross morphology of *T. h.* var. *grandiflora* (scale = 1 cm).

(Fig. 1). Inner surface of perianth tube with longitudinal and horizontal ridges (Fig. 2). Horizontal ridges *ca.* 20. Perianth lobes yellowish brown, equally triangular, narrowed into filiform appendages 29–43 mm long, brownish orange, apical half white. Stamens 6, borne on thickened margin of perianth tube; filaments curved downward; connective broad, connate, forming a loose tube, with 2 distinct tooth-like appendages on free apical margins and 2 thick finger shaped appendages positioned slightly above marginal ones (Fig. 2). Stigma 3-lobed, purplish olive green (Fig. 2). Immature fruit brown.

*Other specimens examined.* MALAYSIA, Maliau Basin Conservation Area, Sabah: 04°45'40"N, 116°56'48"E, 528 m alt., from the Studies Center to Camp Seraya, Maliau Basin Conservation Area, 18 Aug. 2013, H. Tsukaya, M. Suleiman & H. Okada KKT-17 (BORH, TI, KYO; some of the specimen were preserved in 50% ethanol in all herbaria).

*Note.* As shown in Figure 3, *Thismia hexagona* develops inflorescences continuously on elongating rhizomes. In mature individuals, inflorescences and short roots develop on all nodes of the rhizome (indicated by white arrowheads in Fig. 3). This is an unusually vigorous species of *Thismia*, resulting in large populations. *T. hexagona* var. *hexagona* was found among leaf litter in a lowland dipterocarp forests near a stream (Dančák *et al.*, 2013). It rarely occurs with other green-leaved plants. While not co-occurring, other mycotrophs, such as *Epirixanthes elongata* Blume (Polygalaceae) and *Lecanorchis betungkerihunensis* Tsukaya et H.Okada (Orchidaceae), were also in the same forest.

#### *Other localities recorded by photographs*

One of us (HT) noticed this taxon in photographs taken at several places in Sabah. After examining living material in the Maliau Basin Conservation Area, we reexamined the photos and



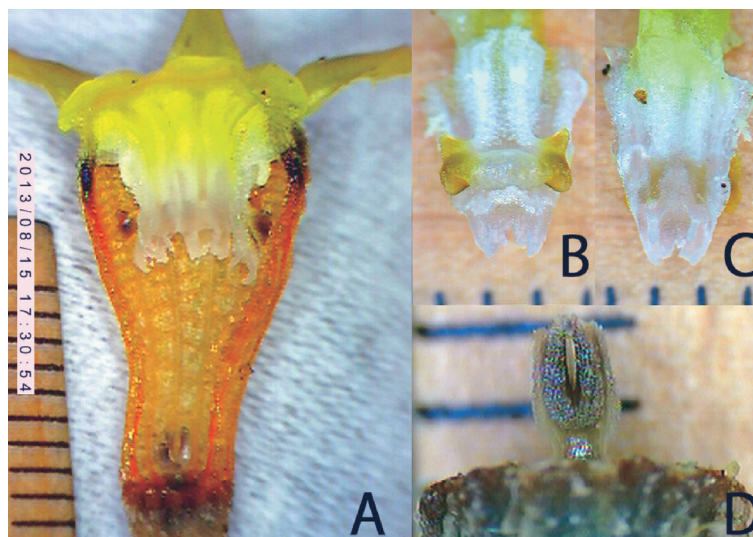


FIG. 2. Flower structure of *Thismia hexagona* var. *grandiflora*. A, Inner structure of perianth tube. B, C, Anther; abaxial and adaxial views. D, Lateral view of stigma. Scale = 1 mm. All photos are of individuals at the type locality.

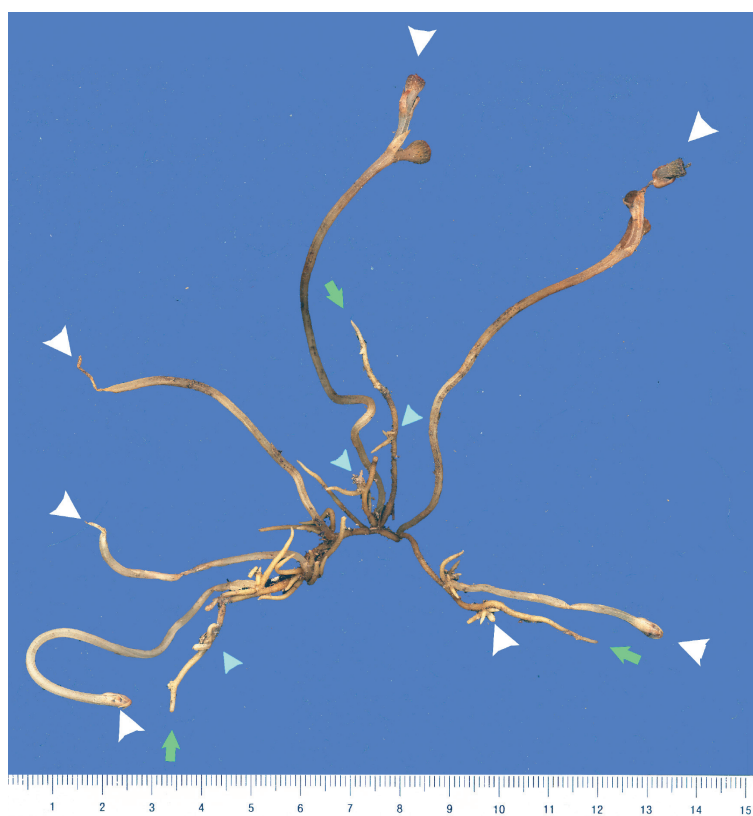


FIG. 3. *Thismia hexagona* var. *grandiflora*. Active branching and development of new inflorescences are shown. Large white arrowheads indicate mature inflorescence; small light-blue arrowheads indicate immature inflorescence or inflorescence buds. Green arrows indicate tip of rhizome. Scale = 1 cm.

concluded that *Thismia hexagona* var. *grandiflora* also occurs in Imbak Canyon, Sabah, Malaysia (Mr. Yuji Kamiya, Mr. Makoto Yokotsuka, Ms. Suzana Sabran, personal communication). Knowing whether the distribution of the two varieties of *T. hexagona* overlaps would be of interest. Further exploration in the border areas between Sabah and Brunei are anticipated.

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